Claims

1. A fuel injection system for internal combustion engines, having a fuel injector (1) that can be supplied from a high- pressure fuel source (2, 81), in which between an injection valve (6) and the high-pressure fuel source (2, 81) a pressure booster (5) is disposed that has a booster piston (12), which divides a pressure chamber (11), which can be connected to the high-pressure fuel source (2, 81), from a high-pressure chamber (20) acting upon a nozzle chamber (29) of the fuel injector (1), and a pressure change in a differential pressure chamber (16) of the pressure booster (5) causes a pressure change in the high-pressure chamber (20), and the injection valve (6) includes a nozzle needle (30), with which injection openings oriented toward a combustion chamber (7) can be opened or closed, characterized in that the nozzle needle (30) includes a first nozzle needle part (31) and a further nozzle needle part (32), which being triggerable as a function of pressure open and close various injection cross sections (42, 43) of an injection nozzle (41).

2. The fuel injection system of claim 1, characterized in that the nozzle needle parts (31, 32) of the nozzle needle (30) are guided one inside the other.

3. The fuel injection system of claim 1, characterized in that the nozzle needle parts (31, 32) of the nozzle needle (30) have surface areas (35, 40) that make a hydraulic pressure actuation possible.

4. The fuel injection system of claim 3, characterized in that the first nozzle needle part (31) includes a pressure shoulder (35), which is actuatable via the fuel, at high pressure, entering a nozzle chamber (29).

5. The fuel injection system of claim 3, characterized in that the second nozzle needle part (32) includes a pressure shoulder (40), which is disposed on its end toward the combustion chamber.

6. The fuel injection system of claim 3, characterized in that a hydraulic chamber that via a pressure shoulder (40) actuates the second nozzle needle part (32) is defined by an end face (45) of the first nozzle needle part (31) and a nozzle body face (44) toward the combustion chamber.

7. The fuel injection system of claim 6, characterized in that the nozzle body face (44) toward the combustion chamber is embodied conically.

8. The fuel injection system of claim 6, characterized in that the hydraulic chamber that surrounds the pressure shoulder (40) of the second nozzle needle part (32) is acted upon by fuel from the nozzle chamber (29) via an annular gap (50) when the first nozzle needle part (31) is actuated in the opening direction.

9. The fuel injection system of claim 1, characterized in that stroke-limiting stops (33, 34) disposed in a closing chamber (21) are associated with the first nozzle needle part (31) and the second nozzle needle part (32), and at least one of the nozzle needle parts (31, 32) is acted upon a closing spring element (38, 39).

10. The fuel injection system of claim 1, characterized in that the first nozzle needle part (31) opens and closes a first injection cross section (42), and the second nozzle needle part (32) opens and closes a second injection cross section (43).

11. The fuel injection system of claim 10, characterized in that after the opening of the first injection cross section (42) by the first nozzle needle part (31) upon pressure- dependent

actuation of the second nozzle needle part (32), the second injection cross section (43) is opened in addition to the first injection cross section (42).

12. The fuel injection system of claim 10, characterized in that the first and second injection cross sections (42, 43) are embodied as concentric circles of holes on the end toward the combustion chamber of a nozzle body (44) of the fuel injector (1).

13. The fuel injection system of claim 1, characterized in that the first nozzle needle part (31) and the second nozzle needle part (32) each have respective leak fuel drainage recesses (46, 48) on their circumference.

14. The fuel injection system of claim 13, characterized in that the leak fuel drainage recesses (46, 48) communicate via a leak fuel conduit (47) that is provided in one of the nozzle needle parts (31, 32) and discharge into a leak fuel line (49) toward the housing.

15. The fuel injection system of claim 1, characterized in that the nozzle needle (5) includes a pressure chamber (11), which is acted upon via a line (4) from the high-pressure fuel source (2, 81), and has a differential pressure chamber (16), which is in communication with the high-pressure fuel source (2, 81) via a magnet valve (8) of lines (18, 19) and includes a high-pressure chamber (20), which subjects a nozzle chamber (29), surrounding the coaxial nozzle needle (30), to high pressure.

16. The fuel injection system of claim 15, characterized in that the differential pressure chamber (16) of the pressure booster (5) communicates with a closing chamber (21) of the injection valve (6).

17. The fuel injection system of claim 15, characterized in that the closing chamber (21) of the injection valve (6) is acted directly upon by pressure from the high-pressure fuel source (2, 81) via a line (40, 60).

18. The fuel injection system of claim 16, characterized in that the closing chamber (21) of the injection valve (6) is acted upon by pressure, parallel to a line (22) from the differential pressure chamber (16) or parallel to a line (60) from the high-pressure fuel source (2, 81), via a line (25) which includes a check valve/throttle restriction (24) and is supplied from the high-pressure chamber (20).

19. The fuel injection system of claims 1 and 16 through 18, characterized in that when the valve (8) is deactivated, a fluidic communication (4, 18, 19, 22, 60, 23, 85) is established from the high-pressure source (2, 81) to the closing chamber (21, 82).

20. The fuel injection system of claims 1 and 16 through 18, characterized in that when the valve (8) is deactivated, a fluidic communication (4, 18, 19, 22; 60, 23, 85, 25, 28) is established from the high-pressure source (2) to the nozzle chamber (29).

21. The fuel injection system of claim 6, characterized in that at least the first nozzle needle part (31) can be acted upon by pressure that can be generated in the closing pressure chamber (21, 82).

22. The fuel injection system of claim 2, characterized in that the first nozzle needle part (31) and the second nozzle needle part (32) are acted upon, counter to the action of closing springs (38, 39) first nozzle control chamber (82) that can be acted upon with the interposition of a throttle restriction (85), and independently thereof the second nozzle needle part (32) can be actuated via a pressure relief of a second nozzle control chamber (83).

23. The fuel injection system of claim 22, characterized in that the second nozzle control chamber (83) is sealed off from the nozzle control chamber (82) by a sleevelike body (89).

24. The fuel injection system of claim 22, characterized in that the second nozzle needle part (32) includes a longitudinal conduit (84), by way of which reference leakage is diverted into the second nozzle control chamber (83) and a relief line (88).

25. The fuel injection system of claim 22, characterized in that the reference leakage flows away into the nozzle control chamber (83) between the first and second needle parts (31, 32) via the longitudinal conduit (84) between the sleevelike body (89) and the inner needle part (32).